Principal component analysis of variation in milk odd- and branched-chain fatty acids in dairy ewes

P.G. Toral[1], G. Hervás[1], M. Plante-Dubé[2], E. Barrio[1], R. Gervais[2] and P. Frutos[1]
[1]Instituto de Ganadería de Montaña (CSIC-Universidad de León), Finca Marzanas, 24346, Grulleros, León, Spain, [2]Département des Sciences Animales, Université Laval, 2425 rue de l'Agriculture, Québec G1V 0A6, Canada; pablo.toral@csic.es

Milk odd- and branched-chain fatty acids (OBCFA) are largely derived from bacteria leaving the rumen, which has encouraged research on their use as non-invasive markers of rumen function. In dairy cows, studies have examined relationships between milk OBCFA and dietary components, such as starch, fibre, protein or lipids. However, we are not aware of targeted research on this topic in sheep. Therefore, with the aim of gaining insight into factors controlling milk OBCFA concentrations in dairy ewes, a principal component analysis (PCA) was conducted to examine relationships between diet composition and milk OBCFA profile. A database was compiled using lot observations from 14 trials carried by our team that examined the effects of lipid supplementation on milk fatty acid (FA) profile in dairy ewes (42 dietary conditions). Diets consisted of total mixed rations based on alfalfa hay (in proportions that ranged from 19 to 71%) and concentrates, and contained no additional lipid or lipid supplements from plant or marine origin. The PCA discriminated 2 principal components (PC) that described 46.0 (PC1) and 21.4% (PC2) of the variation in data, and a PC3 that accounted for 9.6% of total variability. The score plot showed that PC1 tended to separate two major groups of lots based on the addition or not of lipids to the ration. The loading plot showed that concentrations of milk 14:0 *iso*, 15:0, 15:0 *anteiso*, 17:0 and *cis*-9 17:1 loaded opposite to dietary unsaturated C18 FA and total FA, and both groups of variables were clearly correlated with PC1, which supports a major role of dietary lipids controlling milk OBCFA. However, milk 13:0 *anteiso* was only correlated, positively, with PC2, which seemed to be influenced by other dietary components, although relationships were less clear. Dietary starch loaded opposite to milk 13:0 *iso* and 15:0 *iso*, and to forage:concentrate ratio and ADF, while crude protein positioned close to the origin of the plot, dismissing its relevance in determining milk OBCFA profile. In conclusion, this PCA would support relevant relationships between diet composition and milk OBCFA in dairy ewes, the strongest influence being that of dietary lipids. Acknowledgements: project AGL2017-87812-R, AEI/FEDER, UE; Ramón y Cajal program, RYC-2015-17230, MINECO/ESF, UE.

Relationships between dietary starch and milk odd- and branched-chain fatty acids in ewes fed oils

P.G. Toral[1], P. Frutos[1], M. Plante-Dubé[2], A.G. Mendoza[1], R. Gervais[2] and G. Hervás[1]
[1]Instituto de Ganadería de Montaña (CSIC-Universidad de León), Finca Marzanas, 24346, Grulleros, León, Spain, [2]Département des Sciences Animales, Université Laval, 2425 rue de l'Agriculture, Québec G1V 0A6, Canada; pablo.toral@csic.es

Ruminal bacteria synthesise odd- and branched-chain fatty acids (OBCFA) that can be transferred to milk. Since different bacterial populations have specific enzymes that determine the products of OBCFA synthesis, variations in the concentration of these lipids in milk may reflect changes in the rumen bacterial community. In cows, increasing dietary starch level is known to foster the growth of amylolytic bacteria and limit that of cellulolytic species, reducing milk iso FA concentrations. In a preliminary principal component analysis, we observed a stronger relationship of milk OBCFA with dietary lipids than with starch level in dairy ewes. Therefore, this study examined the relationships between dietary starch and milk OBCFA concentrations in sheep fed lipid supplements with the objective of determining if the presence of additional fat may affect the response of milk OBCFA to starch level. To that aim, a database with lot observations from 14 nutritional trials was used. A total of 47 lots of ewes received lipid supplements, whereas their respective controls (27 lots) were fed the same basal diets with no supplementation. Starch levels were similar in both treatments and ranged from 108 to 257 g/kg diet DM. Relationships between milk OBCFA and starch level were examined using the MIXED procedure of SAS. Prediction models included the fixed effects of the experimental treatment (control vs supplemented), the linear and quadratic effects of starch level, and the interactions between them. In general, prediction models showed different intercepts in the two treatments, whereas relationships between OBCFA and starch remained constant irrespective of the level of the latter. Significant, although moderate, interactions were only observed for the negative linear relationships with 17:0 and 14:0 iso, and for the quadratic positive relationship with 13:0 anteiso. Overall, in dairy ewes, the relationship between dietary starch level and milk OBCFA does not appear to be greatly affected by the presence of supplemental lipids, suggesting potentially independent effects of the two dietary components on the rumen bacterial community. Acknowledgements: project AGL2017-87812-R, AEI/FEDER, UE; Ramón y Cajal program, RYC-2015-17230, MINECO/ESF, UE.

Book of Abstracts of the 71st Annual Meeting of the European Federation of Animal Science

Book of abstracts No. 26 (2020)
Virtual Meeting
1-4 December 2020

Relationships between dietary starch and milk odd- and branched-chain fatty acids in ewes fed oils

P.G. Toral[1*], P. Frutos[1], M.Plante-Dubé[2], A.G. Mendoza[1], R. Gervais[2] and G. Hervás[1]

[1]Instituto de Ganadería de Montaña (IGM), CSIC-Universidad de León, León (Spain)

[2]Département des Sciences Animales, Université Laval, Québec (Canada)

*E-mail: pablo.toral@csic.es

1. INTRODUCTION

Ruminal bacteria synthesize **odd- and branched-chain fatty acids** (OBCFA) that can be **transferred to milk**. Thus, milk OBCFA may reflect **changes in the rumen bacterial community**.

In cows, increasing **dietary starch** level is known to foster the growth of amylolytic bacteria and limit that of cellulolytic species, reducing **milk *iso* FA concentration**

In a preliminary PCA, we observed a **stronger relationship** of milk OBCFA **with dietary lipids** than with starch level in dairy ewes.

AIM: To determine if the presence of additional fat may affect the response of milk OBCFA to starch in sheep fed lipid supplements.

2. MATERIAL AND METHODS

Database 14 nutritional experiments (**74 lot observations**) - flock of the IGM

42 dietary conditions, divided in 2 **experimental treatments (T)**:

CONTROL	LIPID
27 lots fed diets with no lipid supplementation	47 lots fed diets supplemented with lipids

Data collected after ≥3 weeks on diets (to ensure stable responses)

Starch levels: 108-257 g/kg DM (similar in both treatments)

Statistical analysis (MIXED and REG procedures of SAS 9.4)

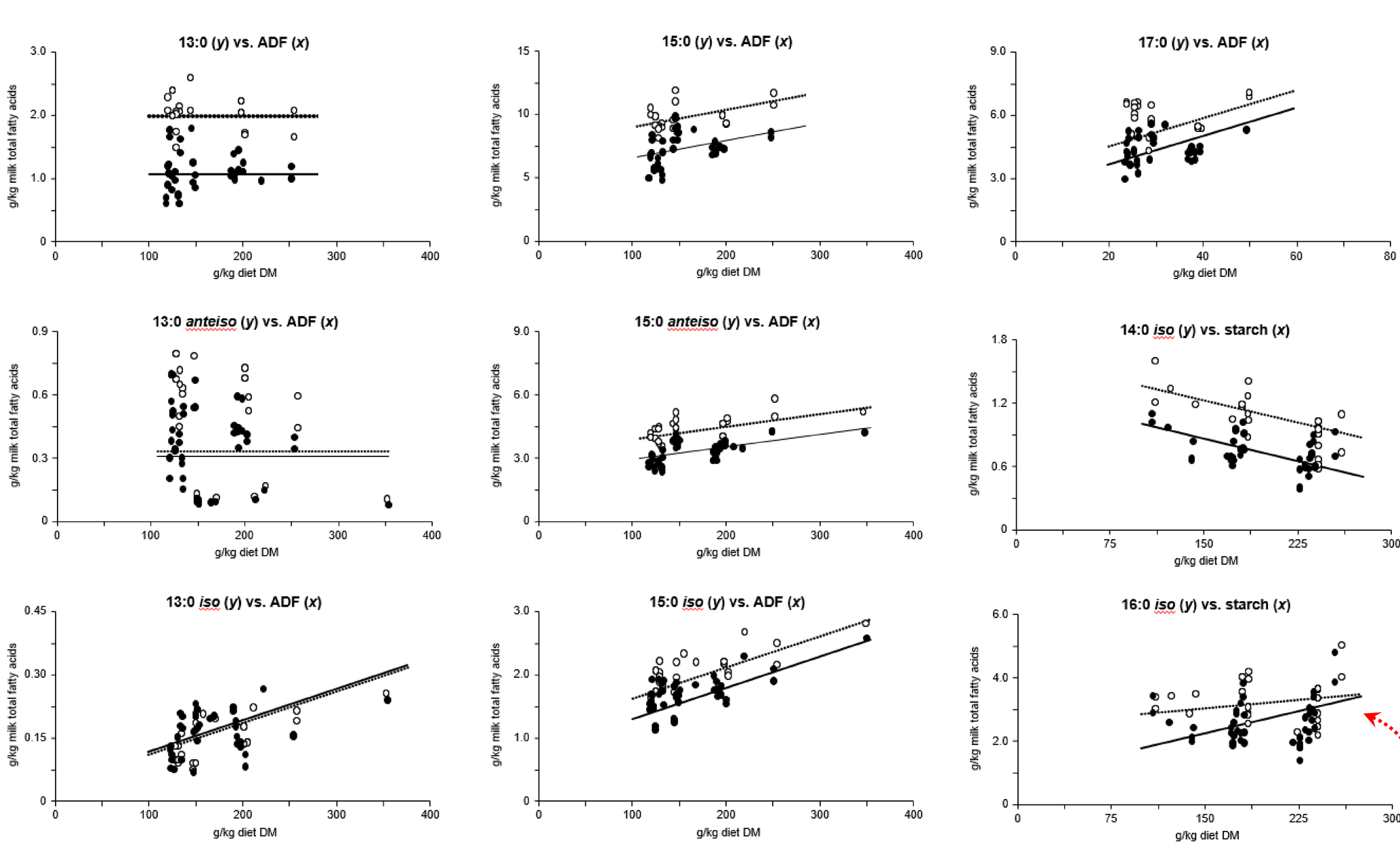
Regression analysis: relationships between dietary starch and milk OBCFA

Prediction model: fixed effects of T, starch level (linear and quadratic), and interactions T x starch level; random effect of experiment

Fit statistics: root mean squared error (RMSE) and R^2 (for linear relationships between studentized residuals of observed and predicted values)

3. RESULTS

In general, prediction models showed different intercepts in the two treatments, whereas **relationships** between OBCFA and starch **remained constant** irrespective of the level of the latter



A significant interaction T x starch level was **only** observed for the relationships with 16:0 *iso*

4. CONCLUSIONS

Overall, in dairy ewes, the relationship between **dietary starch level** and **milk OBCFA** does not appear to be greatly affected by the presence of supplemental lipids, suggesting **potentially independent effects of the two dietary components** on the rumen bacterial community

Acknowledgements: project AGL2017-87812-R, AEI/FEDER, UE; Ramón y Cajal program, RYC-2015-17230, MINECO/ESF, UE)